

# NASA TECH BRIEF

## *Lewis Research Center*



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### Survey of Aircraft Electrical Power Systems

An industry and literature survey has been made of the electrical power systems and equipment in present-day commercial aircraft. Current practice and state-of-the-art in aircraft electric power generation, transformation, distribution, and utilization including present and projected electric loads was investigated.

The present aircraft electrical system (115/200-volt, 3-phase, 400-Hz constant frequency ac) was developed about twenty-five years ago for the relatively small aircraft of that time. Many future aircraft are expected to require much more electrical power, at least part of which must be of very precise quality. Also, recent technical advances may outdate some of the equipment and concepts presently utilized in aircraft. This survey was conducted as an initial step in determining whether the present electrical system will be suitable for future aircraft.

Specific areas investigated included the following:

1. For electrical load analysis, electrical loads were classified and a weight analysis was made of the constant and variable frequency ac motors, and brushless dc motors. Parametric data for components were divided into components in existing aircraft, and current technology components applicable to aircraft. The utilization weights were compared as a function of system electrical frequency (including dc).
2. In the area of power distribution, design considerations of safety, corona, voltage, and frequency levels were investigated. Characteristics and performance data on cables, relays, circuit breakers, contactors, and transformer-rectifier units were collected. Data for voltage and frequency effect on wiring weight were prepared.
3. Power conversion techniques were considered and compared. Parametric weight data were obtained for the various possible techniques.
4. Possible methods of generating electric power were examined including: the present constant speed, constant frequency (CSCF) system, and the variable speed, constant frequency (VSCF), rotating inverter and high-voltage dc systems under development. Analysis indicated that the more advanced generating concepts could offer performance advantages in comparison to the present CSCF systems while still remaining weight competitive. Parametric information on emergency power sources was also collected.
5. The design criteria and performance capabilities of both the hydraulic and pneumatic systems were surveyed since many aircraft loads, such as flight controls, landing gear, brakes, and thrust reversers, are presently serviced by hydraulic or pneumatic power.
6. System control and protection methods in existing aircraft were reviewed and various protection schemes for single and parallel system operations were analyzed.
7. Present techniques of cooling aircraft electrical components and heat transfer systems were studied. Possible improvements in heat transfer methods utilizing state-of-the-art technology were also considered.
8. The objectives and criteria of aircraft electrical system reliability were outlined. The level of reliability currently achieved by various aircraft components and subsystem was also tabulated.

#### Notes:

1. The information obtained in this survey should be of interest to the electrical equipment industry.
2. The following documentation may be obtained from:  
National Technical Information Service  
Springfield, Virginia 22151  
Single document price \$3.00  
(or microfiche \$0.95)

(continued overleaf)

Reference: NASA CR-110693 (N70-32344),  
Investigation and Development of New Concepts  
for Improvement of Aircraft Electrical Power  
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**Patent status:**

No patent action is contemplated by NASA.

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3. Technical questions may be directed to:  
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